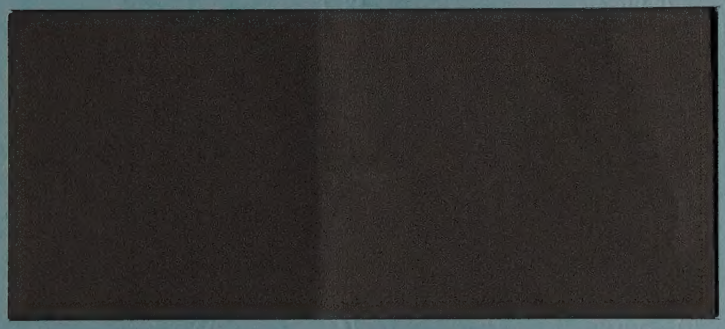
9/83

# LORAIN

## POWER EQUIPMENT



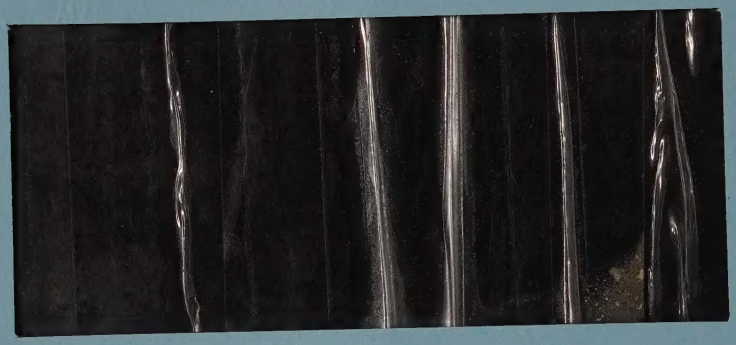
# INSTRUCTIONS

## INSTALLATION

## OPERATION

## MAINTENANCE

RELIANCE COMM/TEC



LORAIN MODEL HSB3H

DC TO DC CONVERTER

Spec. No. 5664-022 Serial No. _____

## LORAIN PRODUCTS
## Division of Reliance Electric Co.

## WARRANTY

Seller warrants that the products it manufactures or sells shall be free from defects in material and workmanship during the first 90 days after the product is activated. During said period, Seller will repair or replace any defective parts free of charge to Buyer, including any labor costs. In addition, Seller shall repair or replace any defective parts, so discovered by Buyer to be defective within two years from the date of shipment of same, provided Buyer promptly so notifies Seller. In no case shall Seller's liability under this warranty extend beyond two years from the date of shipment of said product. This warranty shall not apply to any products which are misused, modified, repaired, or otherwise abused by Buyer or others. The repair or replacement of defective parts, or the refund of the invoice cost thereof, as shall be determined by Seller in its sole discretion, shall be the limit of Seller's liability hereunder and shall be Buyer's sole and exclusive remedy.

Handling or service charges in connection with the return of such products, if approved by Seller, shall be charged as determined by Seller. Seller shall not be liable in any event for any general or special, incidental or consequential damages to Buyer in excess of the amount of the purchase price of the products.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES. SELLER MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE WITH RESPECT TO ANY PRODUCTS EXCEPT AS HEREIN EXPRESSLY PROVIDED.

## SYSTEMS AND EQUIPMENT NOT ECONOMICALLY RETURNABLE TO THE FACTORY

In the event that the product involved is a system or equipment which, in the judgement of Lorain Products, is not economically returnable to the factory or if Lorain Products has performed the installation, supervised the installation, or performed testing and turn-on, circuit components and Lorain repair labor are covered by this warranty for the first 90 days from date of turn-on and circuit components are warranted for two years from the date of shipment. Upon request, Lorain will send a service technician to the site to determine if the unit is defective in circuit components or workmanship, and will repair the equipment. If the failure is Lorain's fault, no invoice for circuit components or repair labor will be issued if the complaint has been issued within the first 90 days from date of turn-on. If the complaint is issued more than 90 days from the date of turn-on but within two years from date of shipment, the customer will be billed at the prevailing Customer Service rates but will not be billed for circuit components. If the problem occurs after two years from the date of shipment, circuit component and repair labor are billable.

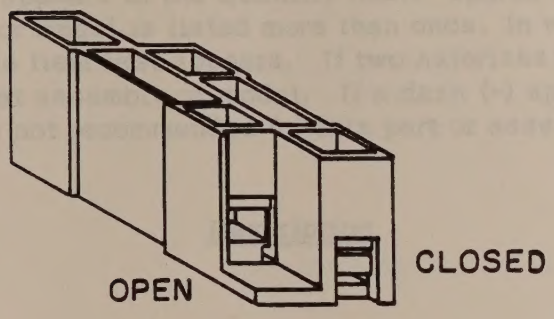
If the problem has been created by misuse or abuse of the equipment or by malfunction of associated equipment or by environmental conditions, at any time after shipment, the customer will be billed for circuit component and labor.

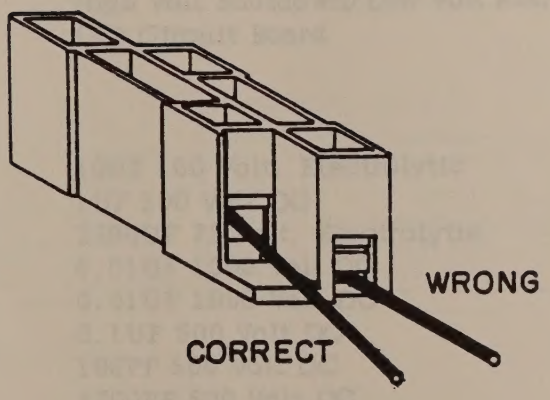
## GENERAL PROVISIONS

Lorain Products shall not be obligated to pay any costs or charges incurred by the customer or by any other party. In no event will Lorain Products be liable for consequential damages. No waiver, alteration or modification of any of the provisions herein shall be binding on Lorain Products unless in writing and signed by an authorized official of Lorain Products. If, during any warranty period, the subject equipment has, in the opinion of Lorain Products, been modified or misrepaired, the warranty will be void unless the modifications or repairs have been made after consultation with Lorain Products and upon the recommendation of Lorain Products.

## WARNING

When making electrical connections, assure that the wire is properly inserted between the metal clamps of the terminal (see sketch). Inserting the wire under the lower clamp of the terminal creates a potential fire hazard.



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*In Mexico —*
Productos Lorain de Mexico, S.A. de C.V., Apartado Postal 77001

RELIANCE

# ELECTRICAL PARTS LIST
# LORAIN MODEL HSB3H DC TO DC CONVERTER
# SPEC. NO. 5664-022

This Electrical Parts List is arranged alphabetically by part name. Spare parts are not usually required if adequate standby equipment is available and if the LORAIN EQUIPMENT is installed at an accessible location so that parts can readily be obtained from Lorain Products stock. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate. The quantity of spare parts listed should be sufficient for ten or less assemblies or models for at least 18 months. If a single asterisk (*) appears in the Quantity Recm. Spares column, it indicates the part, assembly, or model is listed more than once, in which case, use the quantity where the item first appears. If two asterisks (**) appear, refer to the sub-list for that assembly or model. If a dash (-) appears, this indicates that spares are not recommended for this part or assembly.

| Ref. Desig. | LPC Part No. | Description | Quantity Recm. Spares |
|---|---|---|---|
| **ASSEMBLIES** | | | |
| A1 | 4338-365 | Driver PW Board | 1 |
| A2 | 4337-325 | Power Amplifier PW Board | 1 |
| A3 | 4865-646 | Voltage/Current Regulator PW Board | 1 |
| A4 | 4863-760 | High Volt Shutdown/Low Volt Alarm PW | 1 |
| LED1 | 4257-022 | LED Circuit Board | 1 |
| **CAPACITORS** | | | |
| C1 | 2731-106 | 10UF 100 Volt, Electrolytic | - |
| C2 | 2713-173 | 1UF 100 Volt DC | 1 |
| C3 | 2731-270 | 2500UF 75 Volt, Electrolytic | - |
| C4 | 2724-140 | 0.01UF 1000 Volt DC | 1 |
| C5 | 2724-140 | 0.01UF 1000 Volt DC | * |
| C6 | 2724-106 | 0.1UF 500 Volt DC | 1 |
| C7 | 2724-105 | 100PF 500 Volt DC | 1 |
| C8 | 2724-137 | 4700PF 500 Volt DC | 1 |
| C9 | 2724-106 | 0.1UF 500 Volt DC | * |
| C10 | 2731-652 | 170UF 150 Volt, Electrolytic | - |
| C11 | 2724-105 | 100PF 500 Volt DC | * |
| C12 | 2724-105 | 100PF 500 Volt DC | * |
| C13 | 2724-106 | 0.1UF 500 Volt DC | * |
| C14 | 2724-105 | 100PF 500 Volt DC | * |
| C15 | 2724-106 | 0.1UF 500 Volt DC | * |
| C16 | 2724-106 | 0.1UF 500 Volt DC | * |
| C17 | 2731-652 | 170UF 150 Volt, Electrolytic | - |

# ELECTRICAL PARTS LIST
# LORAIN MODEL HSB3H DC TO DC CONVERTER
# SPEC. NO. 5664-022

| Ref. Desig. | LPC Part No. | Description | Quantity Recm. Spares |
|---|---|---|---|
| **CIRCUIT BREAKERS** | | | |
| CB1 | 2566-114 | 25 Amp 32 Volt DC | 1 |
| **DIODES** | | | |
| CR1 | 2812-522 | 1N5402, Silicon | 2 |
| CR2 | 2812-522 | 1N5402, Silicon | * |
| CR3 | 2813-144 | 1N1202A, Silicon | 1 |
| **FUSES** | | | |
| F1 | 2483-423 | 5 Amp, Cartridge | 3 |
| **INDUCTORS** | | | |
| L1 | 4411-597 | DC Filter | - |
| L2 | 4421-517 | DC Filter | - |
| L3 | 4411-124 | DC Filter | - |
| **METERS** | | | |
| M1 | 2943-431 | 0-150 Voltmeter, DC | - |
| M2 | 2923-439 | 0-5 Ammeter, DC | - |
| **RECTIFIERS** | | | |
| A5 | 2822-055 | 30 Amp 400 Volt Bridge | 1 |
| **RESISTORS** | | | |
| R1 | 2635-701 | 46.4K Ohm 1 Watt, Fixed | 1 |
| R2 | 2615-351 | 4.7M Ohm 1/2 Watt, Fixed | 1 |
| R3 | 2635-744 | 332K Ohm 1 Watt, Fixed | 1 |
| R4 | 2651-578 | 8.2K Ohm 6.5 Watt, Fixed | 1 |
| R5 | 2651-515 | 150 Ohm 6.5 Watt, Fixed | 1 |
| R6 | 2615-476 | 5.6K Ohm 1 Watt, Fixed | 1 |
| R8, R11 | 2635-534 | 130 Ohm 1 Watt, Fixed | 1 |
| **TRANSFORMERS** | | | |
| T1 | 4471-023 | Power | - |
| T2 | 4422-527 | Current | - |

# ELECTRICAL PARTS LIST
# LORAIN MODEL HSB3H DC TO DC CONVERTER
# SPEC. NO. 5664-022

| Ref. Desig. | LPC Part No. | Description | Quantity Recm. Spares |
|---|---|---|---|
| MISCELLANEOUS | | | |
| | 2488-141 | Fuseholder | 1 |

**LORAIN PRODUCTS**
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# 1. SPECIFICATION

1.1 **GENERAL:** This DC to DC Converter changes 48 volts DC (positive ground) to 130 volts DC for either positive or negative grounded systems.

1.2 **OUTPUT RATINGS**

1.2.1 Voltage: Negative or positive 130 volts DC nominal. Adjustable over the range of 123.5 to 136.5 volts.

1.1.1 Regulation
(A) Static: Steady state output voltage remains within ± 1% of the adjusted voltage for any load current from no load to full load for the input voltage range of 42 to 56 volts DC.

(B) Dynamic: For a step load change of 50% of full load within the range of 10% to 100% of full rated current, the maximum voltage transient will not exceed 5% of the initial steady state voltage. Refer to paragraph 1.8.1.

1.2.2 Filtering
(A) Voice Band: Noise is less than 26 dBrn C message. Refer to paragraph 1.8.1.
(B) Wide Band: Does not exceed 1.3 volts peak to peak over the frequency range of 10 Hz to 50 MHz. Refer to paragraph 1.8.1.

1.2.3 Current: 3 amperes

1.3 **INPUT RATINGS**

1.3.1 Voltage: 48 volts DC (positive ground) - Will operate over a range of 42 to 56 volts DC. Converter will tolerate a range of 40 to 60 volts DC with no adverse effects.

1.3.2 Filtering: Noise reflected back to a 100 ampere hour battery is less than 26 dBrn. Refer to paragraph 1.8.1.

1.3.3 Typical Input Currents
(A) No Load: 0.35 amperes at 48 volts DC
(B) Full Load: 9.6 amperes at 48 volts DC
(C) Does not exceed 12.1 amperes at maximum overload with the input voltage within the range of 42 to 56 volts DC.

1.4 **STANDARD FEATURES**

1.4.1 Input Protection
Undervoltage: Low battery voltage sensing circuit causes output voltage and current to be reduced to zero when the input voltage goes below 37 volts. Output current is automatically restored up to maximum overload when input voltage goes above 42 volts.

1.4.2 Output Protection
(A) Short Circuit: One 5 ampere Bussmann Type BAF fuse.
(B) Current Limiting: Circuit limits DC output current to 110% of full load at nominal input.
(C) Overvoltage: Voltage trip circuit breaker and high voltage sensing circuit disconnect the input voltage when the output voltage exceeds 136.5 volts.

1.4.3 Audible Noise: Operating frequency beyond audible range.

1.4.4 Meters
(A) 0-150 volt, 2 1/2 inch rectangular type DC voltmeter, ± 2% accuracy at full scale, MODUTEC (or equivalent), 2.41 inch scale length.
(B) 0-5 ampere, 2 1/2 inch rectangular type DC ammeter, ± 2% accuracy, MODUTEC (or equivalent), 2.41 inch scale length.

# 1. SPECIFICATION

1.4.5 Series Output Diode: Output diode, which enables paralleling with other converters, may be connected in either negative or positive lead. Load may not be shared proportionately between paralleled units. Failure in one converter will not affect the others.

1.4.6 Alarms

(A) If the output voltage exceeds a preset limit (factory set at 136.5 ± 0.5V), circuits cause two alarm circuits to close, ground to be made available for two alarm circuits, a CONVERTER FAIL lamp to light, and the converter to be turned off.

(B) If the input or output voltage goes below a preset limit (factory set at 37V for low input; 123.5 ± 0.5V for low output), or if the converter is manually turned off, circuits cause two alarm circuits to close, ground to be made available for two alarm circuits, and a CONVERTER FAIL lamp to light.

1.4.7 Mounting: Universal angle provided for either 19 inch (1 3/4 inch multiple drilling) or 23 inch (1 inch or 1 3/4 inch multiple drilling) relay rack mounting.

## 1.5 ENVIRONMENTAL RATINGS

1.5.1 Operating Ambient Temperature Range: 0° C to +50° C (+32° F to +122° F)
1.5.2 Storage Temperature Range: -20° C to +65° C (-4° F to +149° F)
1.5.3 Heat Dissipation: 242 BTU/HR (48 volt input at 130 volt output and full load)

1.5.4 Ventilation Requirements

(A) Ventilation: This converter should be mounted so that bottom and top ventilating openings are not blocked and air entering the bottom of the cabinet does not exceed +50° C (+122° F).

(B) Spacing: It may be necessary to allow a minimum of 1 3/4" spacing between this converter and other heat producing equipment.

(C) Stacking: A maximum of six converters may be stacked, one above the other, with 1 3/4" minimum spacing. Additional converters may be stacked provided a baffle plate or increased spacing is used.

## 1.6 ACCESSORIES: None

## 1.7 MISCELLANEOUS

1.7.1 Schematic Diagram: SD-5664-022
1.7.2 Wiring Diagram: T-5664-022
1.7.3 Instructions: Section 3441

## 1.8 SPECIFICATION NOTES

1.8.1 This parameter is quaranteed by Engineering Design and test. Parameter is not production tested.

# 2. DIMENSIONS

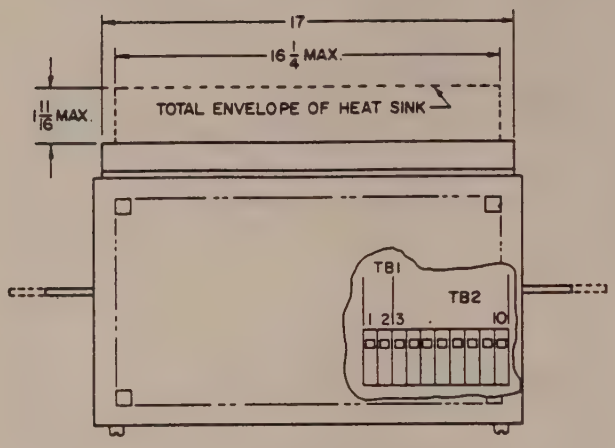



FIG. 3
TOP VIEW

NOTES

1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. WEIGHT
   (A) SHIPPING: 27 LBS.
   (B) NET: 22 LBS.
3. FINISH: EQUIPMENT LIGHT GRAY.
4. INDICATES VENTILATING GRILLE

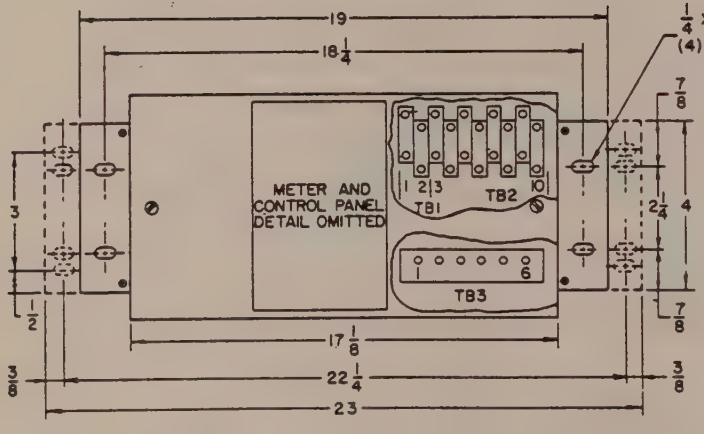



FIG. 1
FRONT VIEW

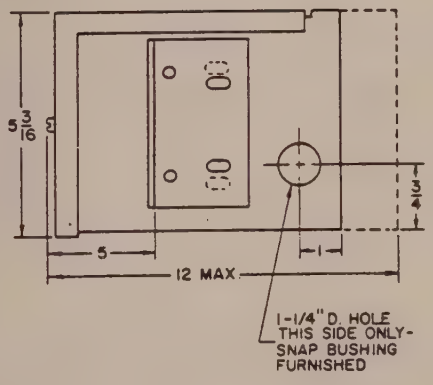
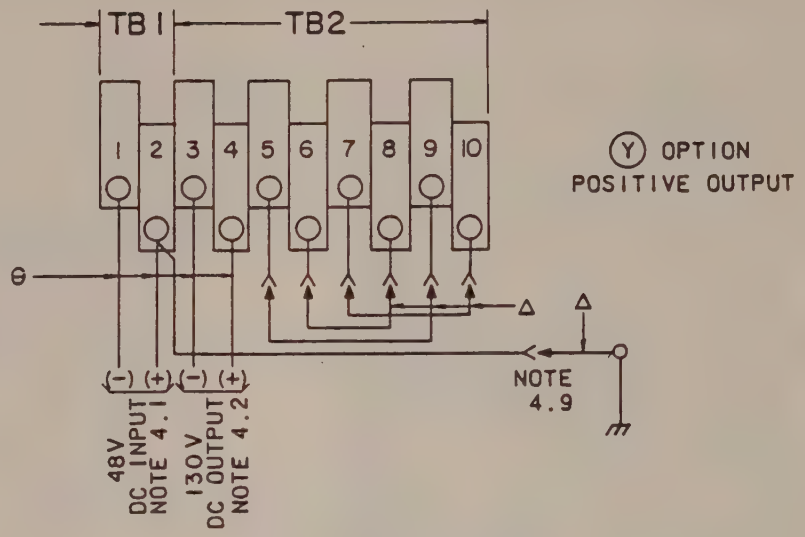
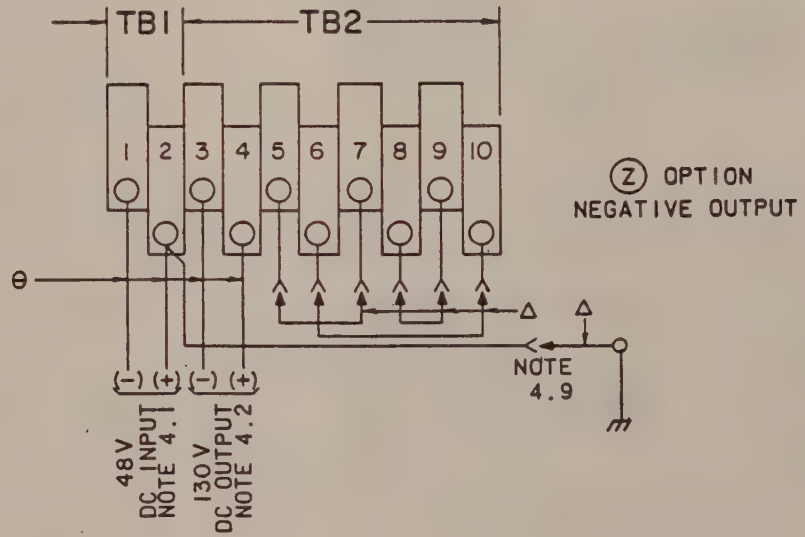
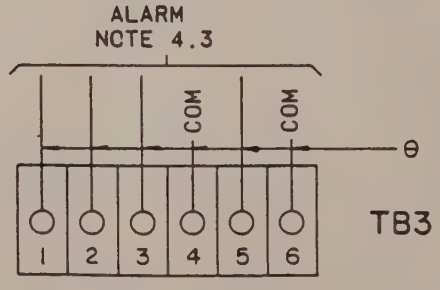



FIG. 2
SIDE VIEW

# 3. INSTALLER'S CONNECTIONS



# 4. INSTALLER'S INFORMATION NOTES

4.1

| DC INPUT (TB1) | | | | |
|---|---|---|---|---|
| Terminals | | | | |
| Capacity | Type | Loop Length - Ft | Recm Wire Size | Recm Fusing |
| 22 to 8 Ga. | Saddle Clamp | 50 | 12 Ga. | 15 amperes |
| | | 100 | 8 Ga. | |

4.2

| DC OUTPUT (TB2) | | | |
|---|---|---|---|
| Terminals | | | |
| Capacity | Type | Loop Length - Ft | Recm Wire Size |
| 22 to 8 Ga. | Saddle Clamp | 50 | 18 Ga. |
| | | 100 | 14 Ga. |

4.3

| ALARMS (TB3) | | |
|---|---|---|
| Terminals | | |
| Capacity | Type | Recm Wire Size |
| 16 Ga. Max. | 6-32 Screw | 18 Ga. |

4.4 DC wire sizes are sufficient to restrict the voltage drop to one volt or less at full rated current for the loop lengths shown. The loop length is the sum of the positive and negative leads.

4.5 Wire sizes meet those recommended in the 1978 National Electric Code Table 310-16 for +75° C conductor temperature.

4.6 Alarm condition causes circuits to close between terminals 3 to 4 and 5 to 6 of terminal block TB3. Ground is also furnished at terminals 1 and 2 of terminal block TB3.

4.7 Δ indicates wiring furnished with the converter to be installed by the customer.

4.8 θ indicates wiring furnished and installed by the customer.

4.9 Positive ground to chassis provided by jumper. Removal optional after installation.

LORAIN PRODUCTS CORP.
Operating Methods and
Circuit Description

# "HSB" SERIES
# DC TO DC CONVERTERS

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## 1. MODEL DATA

### General

**1.01** Refer to the appropriate Power Data Sheet for information concerning the input and output ratings, operating limits, dimensions, recommended input and output lead sizes, fusing, and terminal lug capacity for the following DC to DC Converters:

| Model | Spec. No. |
|---|---|
| HSB3H | 5664-022 |
| HSB6H | 5664-023 |
| HSB8B | 5653-027 |
| HSB16A | 5635-007 |
| HSB16B | 5653-028 |
| HSB16B | 5653-030 |
| HSB30A | 5645-002 |
| HSB8A | 5625-003 |

## 2. DESCRIPTION

### General

**2.01** This DC to DC Converter operates from nominal 48 volts DC to provide filtered and regulated DC to the load. This Converter is a compact unit designed with a high frequency switching circuit to maintain audible noise levels to an absolute minimum.

**2.02** This Converter is equipped with a High Voltage Shutdown/Low Voltage Alarm circuit. In the event of a high output voltage condition, the Converter will shutdown; while a low output voltage condition will cause an alarm to be extended.

**2.03** A low battery sensing circuit causes output voltage and current to be reduced to zero when the input voltage goes below 37 volts. Output current capability is restored up to maximum rated load when input voltage goes above 42 volts.

**2.04** This Converter is also equipped with a current limiting circuit which will prevent further increase of output current above a preset (adjustable) level.

### Accessories

**2.05** An accessory for Model HSB16A (5653-007) is available for changing the output voltage adjustable range from 22.8 - 25.2 to 25.17 - 27.83. This option is designated "X" on Drawing SD-5635-0007.

**2.06** An accessory for Model HSB30A (5645-002) is available for changing the output voltage adjustable range from 22.8 - 25.2 to 20.0 - 24.0 volts. This option is designated "X" on Drawing SD-5645-002.

## 3. INSTALLATION

### Location

**3.01** This DC to DC Converter will operate best in a well ventilated area which has an ambient temperature range of 0° C (32° F) to 50° C (122° F).

### Mounting

**3.02** This Converter is designed for mounting in 19 or 23 inch relay racks.

> CAUTION: In mounted position, ventilation openings at the top and bottom of the Converter cabinet must be unobstructed. This is essential for proper cooling during operation. The temperature of air entering the cabinet must not exceed 50° C (122° F). Refer to Power Data Sheet for spacing and baffle plate requirements.

### Electrical Connections

**3.03** Installer's input, output, and alarm connection terminals are accessible by removing the front cover of the unit. The terminal blocks are located at the front right side of the unit. Installer connections are shown on the Power Data Sheet.

## 4. ADJUSTMENT

### General

**4.01** All adjustment potentiometers are located on the plug-in circuit cards at the front left side of the unit. To gain access to the plug-in circuit cards, it is necessary to remove the front cover of the Converter.

### Output Voltage Adjustment

**4.02** The output voltage adjustment potentiometer OUTPUT VOLTAGE (R3), located on circuit card VR-A3, sets the output voltage level of the Converter. Unless otherwise specified, the output voltage has been factory adjusted to the output voltage given in Table A. Should readjustment become necessary, follow the procedure given below.

a) Adjust the output votlage to the desired level by means of potentiometer OUTPUT VOLTAGE (R3). The output voltage can be monitored on output voltmeter M1.

b) To increase output voltage, turn the screwdriver adjustment shaft of potentiometer R3 clockwise; to decrease output voltage, turn the adjustment shaft counterclockwise.

### High Voltage Shutdown Adjustment

**4.03** The high voltage shutdown adjustment potentiometer HIGH VOLTAGE SHUTDOWN (R2), located on circuit card HVS/LVA, sets the value of output voltage at which the Converter will shutdown. Unless otherwise specified, the high voltage shutdown limit has been factory adjusted to the voltage given in Table A. Should readjustment become necessary, follow the procedure given below.

> CAUTION
>
> It may be necessary to disconnect the load from the Converter output to perform this adjustment, since the Converter

| Model & Spec. | Output Voltage Volts | Current Limit, % | High Voltage Shutdown, Volts | Low Voltage Alarm, Volts |
|---|---|---|---|---|
| HSB3H 5664-022 | 130 | 110 | 136-137 | 123-124 |
| HSB6H 5664-023 | 130 | 110 | 136-137 | 123-124 |
| HSB8B 5653-027 | 48 | 110 | 51.8-52.6 | 45.4-46.2 |
| HSB16A 5635-007 | 24 | 110 | 25-25.4 | 22.6-23 |
| HSB16A 5635-007 e/w "X" Option | 26.5 | 110 | 26.6-28.0 | 25-25.4 |
| HSB16B 5653-028 5653-030 | 48 | 110 | 51.8-52.6 | 45.4-46.2 |
| HSB30A 5645-002 | 24 | 110 | 25-25.4 | 22.6-23 |
| HSB30A 5645-002 e/w "X" Option | 22 | 110 | 22.9-23.3 | 20.7-21.1 |
| HSB8A 5625-003 | 24 | 110 | 25-25.4 | 22.6-23 |

TABLE A
FACTORY SETTINGS

will be shut off in the process.

a) Turn the screwdriver adjustment shaft of potentiometer HIGH VOLTAGE SHUTDOWN (R2) fully clockwise.

b) Increase the output voltage of the Converter to the desired shutdown value by turning clockwise the screwdriver adjustment shaft of potentiometer OUTPUT VOLTAGE (R3), located on circuit card VR-A3.

c) Turn the screwdriver adjustment shaft of potentiometer R2 counterclockwise until input circuit breaker CB1 opens.

d) Return potentiometer OUTPUT VOLTAGE (R3) to its original setting and close input circuit breaker CB1.

### Low Voltage Alarm Adjustment

**4.04** The low voltage alarm adjustment potentiometer LOW VOLTAGE ALARM (R1), located on circuit card HVS/LVA-A4, sets the value of output voltage at which the alarm circuits will illuminate lamp CONVERTER FAIL and activate an external alarm, if connected. Unless otherwise specified, the low voltage alarm limit has been factory adjusted to the value given in Table A. Should readjustment become necessary, follow the procedure given below.

a) Turn the screwdriver adjustment shaft of potentiometer LOW VOLTAGE ALARM (R1) fully counterclockwise.

b) Decrease the output voltage of the Converter to the desired alarm value by turning counterclockwise the screwdriver adjustment shaft of potentiometer OUTPUT VOLTAGE (R3), located on circuit card VR-A3.

c) Turn the screwdriver adjustment shaft of potentiometer R1 clockwise, slowly, until lamp CONVERTER FAIL illuminates.

d) Return potentiometer OUTPUT VOLTAGE (R3) to its original setting.

### Gain Adjustment

**4.05** The gain adjustment potentiometer GAIN ADJ (R3), located on circuit card DRV-A1, sets the Converter regulation control loop gain. This potentiometer has been factory set as required. Field adjustment is not recommended.

### Low Battery Shutdown Adjustment

**4.06** The Low Battery Shutdown Adjustment potentiometer (R28), located on circuit card DRV-A1, sets the value of input voltage at which the Converter will shutdown. This limit has been factory set at 37 volts DC. Field adjustment is not recommended.

### Current Limit Adjustment

**4.07** The current limit adjustment potentiometer (R30), located on circuit card DRV-A1, sets the value at which the output current limit circuit will prevent further increase of output current. This limit has been factory set at 110% of rated output current. Field adjustment is not recommended.

## 5. OPERATION

### General

**5.01** This DC to DC Converter operates from nominal 48 volts DC to provide filtered and regulated DC to the load. An output wiring option allows the user to select either positive or negative output. Since the Converter operates without moving parts, it requires no periodic maintenance or adjustment.

### Starting and Stopping

**5.02** To start or stop Converter operation, place circuit breaker CB1 in the ON or OFF position, respectively. The circuit breaker is located on the front panel directly below the meters.

### Metering

**5.03** This DC to DC Converter is equipped with an output voltmeter (M1) and ammeter (M2) which indicate output voltage and cur

rent, respectively.

### Local Alarms

**5.04** CONVERTER FAILURE: Lamp CONVERTER FAILURE (LED1) will illuminate during a high voltage shutdown, low voltage alarm, low battery shutdown, or converter output failure.

### Remote Alarms

**5.05** High Voltage Shutdown and Low Battery Shutdown: Terminals 3 to 4 and 5 to 6 provide closed circuits; while positive battery is provided at terminals 1 and 2 of terminal block TB3 during a high voltage shutdown condition. Circuit breaker CB1 must be reset manually by placing it in the ON position to resume operation. For a description of the low battery sensing circuit (shown on the schematic diagram as "low battery shutdown"), refer to Para. 2.03.

**5.06** Low Voltage Alarm: Terminals 3 to 4 and 5 to 6 provide closed circuits; while positive battery is provided at terminals 1 and 2 of terminal block TB3 during a low voltage alarm condition.

### Fuses

**5.07** The following table lists the function, size, and type of each fuse used in this DC to DC Converter. If replacement becomes necessary, use the size and type listed, or equivalent.

| Function | Size (Amps) | Type |
|---|---|---|
| F1 DC OUTPUT | 20 HSB16A, HSB16B | Bussmann BAF |
| | 40 HSB30A | Bussmann ABU |
| | 10 HSB8A, HSB8B, HSB6H | Bussmann BAF |
| | 5 HSB3H | Bussmann BAF |

### Component Boards

**5.08** Any of the following component boards can easily be replaced as individual assemblies in the event of a failure of some component on a component board.

### Component Boards

| | |
|---|---|
| DRV-A1 (4338-365) | Driver Circuit |
| *DRV-A1 (4338-390) | Driver Circuit |
| PA-A2 (4337-325) | Power Amplifier Assembly |
| **PA-A2 (4337-039) | Power Amplifier Assembly |
| VR-A3 (4865-646) | Voltage Regulator Circuit |
| HVS/LVA-A4 (4863-760) | High Voltage Shutdown/Low Voltage Alarm Circuits |

*In Models HSB8A (5625-003), HSB16A (5635-007), HSB30A (5645-002) only

**In Models HSB16B (5653-028 and 5653-030), HSB30A (5645-002), and HSB6H (5664-023) only.

## 6. CIRCUIT DESCRIPTION

### General

**6.01** The appropriate schematic diagram shows the electrical and functional circuits of these "HSB" Series DC to DC Converters.

### Input Filter

**6.02** Choke L1, diodes CR1 and CR2, and capacitors C1-C6 and C14 (or C16) form an input filter which will suppress any transient input voltages to the Converter.

### Power Amplifier PA-A2 (4337-325)

**6.03** A portion of the DC input is applied to the power amplifier assembly where the DC voltage is controlled by transistors Q1 and Q2, and is then applied to transformer T1.

**6.04** Transistors Q1 and Q2 operate in a

switching mode amplifying a quasi square wave signal generated by the driver circuit card DRV-A1, described later. This amplified square wave is then applied to power transformer T1 primary. Resistors R1-R3, R16, capacitors C1-C3, and diodes CR1 and CR2 suppress voltage spikes across the collectors of transistors Q1 and Q2.

**Power Amplifier PA-A2** (4337-039)

**6.05** A portion of the DC input is applied to the power amplifier assembly where the DC voltage is controlled by transistors Q1-Q4, and is then applied to transformer T1.

**6.06** Transistors Q1-Q4 operate in a switching mode amplifying a quasi square wave signal generated by the driver circuit card DRV-A1, described later. This amplified square wave is then applied to the power transformer T1 primary. Resistors R1-R3, R16, capacitors C1-C3, and diodes CR1 and CR2 suppress voltage spikes across the collectors of transistors Q1-Q4.

**Output Circuit**

**6.07** The applied square wave of transformer T1 primary is induced on the power secondary windings of T1, which are connected to a rectifying network. This rectified DC voltage is then applied to the output terminals of the Converter.

**6.08** The positive output is applied through inductor L2 while the negative output is applied through ammeter M2. If positive output is required, series diode CR3 and output fuse F1 will be in the positive line; likewise, if negative output is required, series diode CR3 and output fuse F1 will be in the negative line.

**6.09** Series diode CR3 isolates the DC to DC Converter from any parallel connected Converters, thus preventing disturbance of bus voltage by a failed parallel connected Converter. Shunt diode CR6 (in some models) prevents complete loss of bus voltage in boost mode operation due to a failed Converter.

**Driver Circuit DRV-A1** (4338-365 or 4338-390)

**6.10** The driver circuit produces the quasi square wave which is applied alternately to the power transistors located in the power amplifier circuit described above.

**6.11** Clock A1 generates a 40 KHz pulse which is applied to voltage/pulse width Converter A1 generating a ramp. The slope of the ramp is determined by the current through resistor R12. This current is proportional to the input battery voltage. The width of the pulse generated by the VPW Converter A1 is determined by the slope of the ramp, by transistor Q6, and by the conduction of photo-coupler Q1. Photo-coupler Q1 is controlled by the regulator circuit. Transistor Q6 is controlled by the instantaneous collector current in the power amplifier circuit. Flip-flop A2 generates a 20 KHz square wave from the pulse produced by clock A1. The clock pulse, VPW converter output, and the square wave are combined in NAND gate A3 to form two out-of-phase variable quasi square waves. The two quasi square waves and their complement are buffered by A4. The quasi-square waves are amplified by transistors Q2-Q5 which operate in a constant current mode while their complement is amplified by transistors Q7 and Q8 which operates as a clamp on transformer T1 primary. Diodes CR12-CR14 provide bias for the amplifier transistors and provide voltage for circuits A1-A4 operation. Windings 1, 2 and 3, 4 of transformer T1 provide base drive voltage; while winding 9, 10 of transformer T1 provides power to operate the regulator and alarm circuits.

**6.12** Battery voltage is applied to a voltage divider consisting of resistor R26 and potentiometer R28. When the divider voltage increases sufficiently to overcome the voltage across zener diode CR17, transistor Q10 will conduct. Transistor Q10, conducting, will bias transistor Q9 off, thus allowing capacitor C13 to charge. When capacitor C13 becomes fully charged, the VPW Converter A1 will begin to deliver maximum pulse width, which will result in full output power of the Converter.

**6.13** The output current of the Converter is detected by a current transformer, located in the power amplifier circuit, and converted to a voltage which is applied to diodes CR20-CR23. This rectified voltage is then applied across capacitor C6. When the charge across capacitor C6 exceeds the reference voltage of zener diode CR1 on mini-board (4337-040) which is located on the driver circuit card, transistor Q6 will begin to conduct. The conduction of transistor Q6 will reduce the conduction angle through diode CR18 and lower the clock frequency through diodes CR19 and resistor R19.

**Voltage Regulator Circuit VR-A3** (4865-646)

**6.14** The voltage regulator circuit monitors the output voltage of the Converter. The output of the voltage regulator provides the VPW Converter with the error signal which will control the output voltage.

**6.15** Comparator A1G3 compares the signal developed across resistor R2 and potentiometer R3, which is proportional to the output voltage, to a reference voltage developed across zener diode CR3. The output of comparator A1G3 is applied through diode CR1 to drive a photo-coupler on the driver circuit card. Regulator A1G2 functions as a series regulator for the isolated supply voltage developed across capacitor C8 and supplies voltage to zener diode CR3 and the photo-coupler on DRV-A1. Diodes CR4-CR11 comprise alternate rectifiers for the 20 KHz power from the driver circuit and the output circuit.

**High Voltage Shutdown Low Voltage Alarm HVS/LVA-A4** (4863-760)

**6.16** The HVS/LVA-A4 circuit card monitors the DC output voltage of the Converter. The circuit card contains two circuits: one that will cause the Converter to shutdown due to a high output voltage, and one that will cause an alarm to be extended due to a low output voltage.

**6.17** DC output voltage is applied across resistor R4 and potentiometer R2, which is adjusted for a high voltage shutdown level. When the output voltage increases, the reference voltage developed across zener diode CR3 will remain stable, thus this difference between the voltage across potentiometer R2 and zener diode CR3 will be detected by comparator A1G1. Comparator A1G1 will swing positive causing light sensitive transistor Q1 to stop conducting, biasing transistor Q2 off and Q3 on. Conduction of transistor Q3 will cause ground to be applied to the trip coil of circuit breaker CB1, thus causing the Converter to shutdown.

**6.18** DC output voltage is applied across resistor R4 and potentiometer R1, which is adjusted for a low voltage alarm level. When the output voltage decreases, the reference voltage developed across zener diode CR3 will remain stable, thus this difference between the voltage across potentiometer R1 and zener diode CR3 will be detected by comparator A1G2. Comparator A1G2 will swing positive causing light sensitive transistor Q4 to stop conducting, biasing transistors Q5 and Q6 off. Non-conduction of transistor Q6 will cause relay K1 to de-energize. Contacts of relay K1, de-energized, will provide two closed loop circuits and supply ground at two terminals for activation of external alarms, if connected.



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# ELECTRICAL PARTS LIST
# LORAIN MODEL HSB3H DC TO DC CONVERTER
# SPEC. NO. 5664-022

This Electrical Parts List is arranged alphabetically by part name. Spare parts are not usually required if adequate standby equipment is available and if the LORAIN EQUIPMENT is installed at an accessible location so that parts can readily be obtained from Lorain Products stock. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate. The quantity of spare parts listed should be sufficient for ten or less assemblies or models for at least 18 months. If a single asterisk (*) appears in the Quantity Recm. Spares column, it indicates the part, assembly, or model is listed more than once, in which case, use the quantity where the item first appears. If two asterisks (**) appear, refer to the sub-list for that assembly or model. If a dash (-) appears, this indicates that spares are not recommended for this part or assembly.

| Ref. Desig. | LPC Part No. | Description | Quantity Recm. Spares |
|---|---|---|---|
| **ASSEMBLIES** | | | |
| A1 | 4338-365 | Driver PW Board | 1 |
| A2 | 4337-325 | Power Amplifier PW Board | 1 |
| A3 | 4865-646 | Voltage/Current Regulator PW Board | 1 |
| A4 | 4863-760 | High Volt Shutdown/Low Volt Alarm PW | 1 |
| LED1 | 4257-022 | LED Circuit Board | 1 |
| **CAPACITORS** | | | |
| C1 | 2731-106 | 10UF 100 Volt, Electrolytic | - |
| C2 | 2713-173 | 1UF 100 Volt DC | 1 |
| C3 | 2731-270 | 2500UF 75 Volt, Electrolytic | - |
| C4 | 2724-140 | 0.01UF 1000 Volt DC | 1 |
| C5 | 2724-140 | 0.01UF 1000 Volt DC | * |
| C6 | 2724-106 | 0.1UF 500 Volt DC | 1 |
| C7 | 2724-105 | 100PF 500 Volt DC | 1 |
| C8 | 2724-137 | 4700PF 500 Volt DC | 1 |
| C9 | 2724-106 | 0.1UF 500 Volt DC | * |
| C10 | 2731-652 | 170UF 150 Volt, Electrolytic | - |
| C11 | 2724-105 | 100PF 500 Volt DC | * |
| C12 | 2724-105 | 100PF 500 Volt DC | * |
| C13 | 2724-106 | 0.1UF 500 Volt DC | * |
| C14 | 2724-105 | 100PF 500 Volt DC | * |
| C15 | 2724-106 | 0.1UF 500 Volt DC | * |
| C16 | 2724-106 | 0.1UF 500 Volt DC | * |
| C17 | 2731-652 | 170UF 150 Volt, Electrolytic | - |

# ELECTRICAL PARTS LIST
## LORAIN MODEL HSB3H DC TO DC CONVERTER
## SPEC. NO. 5664-022

| Ref. Desig. | LPC Part No. | Description | Quantity Recm. Spares |
|---|---|---|---|
| **CIRCUIT BREAKERS** | | | |
| CB1 | 2566-114 | 25 Amp 32 Volt DC | 1 |
| **DIODES** | | | |
| CR1 | 2812-522 | 1N5402, Silicon | 2 |
| CR2 | 2812-522 | 1N5402, Silicon | * |
| CR3 | 2813-144 | 1N1202A, Silicon | 1 |
| **FUSES** | | | |
| F1 | 2483-423 | 5 Amp, Cartridge | 3 |
| **INDUCTORS** | | | |
| L1 | 4411-597 | DC Filter | - |
| L2 | 4421-517 | DC Filter | - |
| L3 | 4411-124 | DC Filter | - |
| **METERS** | | | |
| M1 | 2943-431 | 0-150 Voltmeter, DC | - |
| M2 | 2923-439 | 0-5 Ammeter, DC | - |
| **RECTIFIERS** | | | |
| A5 | 2822-055 | 30 Amp 400 Volt Bridge | 1 |
| **RESISTORS** | | | |
| R1 | 2635-701 | 46.4K Ohm 1 Watt, Fixed | 1 |
| R2 | 2615-351 | 4.7M Ohm 1/2 Watt, Fixed | 1 |
| R3 | 2635-744 | 332K Ohm 1 Watt, Fixed | 1 |
| R4 | 2651-578 | 8.2K Ohm 6.5 Watt, Fixed | 1 |
| R5 | 2651-515 | 150 Ohm 6.5 Watt, Fixed | 1 |
| R6 | 2615-476 | 5.6K Ohm 1 Watt, Fixed | 1 |
| R8, R11 | 2635-534 | 130 Ohm 1 Watt, Fixed | 1 |
| **TRANSFORMERS** | | | |
| T1 | 4471-023 | Power | - |
| T2 | 4422-527 | Current | - |

# ELECTRICAL PARTS LIST
# LORAIN MODEL HSB3H DC TO DC CONVERTER
# SPEC. NO. 5664-022

| Ref. Desig. | LPC Part No. | Description | Quantity Recm. Spares |
|---|---|---|---|
| MISCELLANEOUS | | | |
| | 2488-141 | Fuseholder | 1 |

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CIRCUIT NOTES:

101. FUSES SHOWN IN THIS TABLE ARE NOT PART OF EQUIPMENT

| DESIG | FUSE AMP | POTENTIAL | ONE PER |
|---|---|---|---|
| | | | |
| BATTERY AND POWER SUPPLIES SYMBOLS | | VOLTAGE RANGE 40-60 | |

102. UNLESS OTHERWISE SPECIFIED THE FOLLOWING OPTION IS PROVIDED. Y

| OPTION | REFERENCES | |
|---|---|---|
| | WIRING | CONNECT TB2 JUMPERS |
| POS OUTPUT | Y | 5 TO 9, 6 TO 8, 7 TO 10 |
| NEG OUTPUT | Z | 5 TO 7, 6 TO 10, 8 TO 9 |

103. OPTIONAL FRAME GROUND FOR PROTECTION AGAINST REVERSE BATTERY POLARITY MAY BE REMOVED AFTER INSTALLATION.

EQUIPMENT NOTES:

201. REFER TO PD-5664-022 FOR EXTERNAL CONNECTIONS, FUSING AND WIRE SIZE.

INFORMATION NOTES:

301. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE MICROFARADS, AND VALUES PRECEDED BY THE SYMBOL + (PLUS), OR — (MINUS) ARE IN VOLTS.

302. CODES WITHIN PARENTHESES, AS (4863-760) REPRESENT LPC PART NUMBERS.

303. SEE WIRING DIAGRAM, T-5664-022 FOR LPC PART NUMBERS OF COMPONENTS.

304. HIGHEST REF DESIG. USED ON THIS DRAWING:

| RES. | XMFR | DIODES | ASSYS | FUSES | CAP |
|---|---|---|---|---|---|
| R11 | T2 | CR3 | A5 | F1 | C19 |
| NOT USED | | | | | |
| R7,9,10 | | | | | C9,13,15 |
| | | | | | |
| | | | | | |

REVISIONS

| | | DATE | DESCRIPTION |
|---|---|---|---|
| 1 | M. | | NEW |
| 2 | 1835633 9 24 75 G Sobotka 6-26-75 | | POLARITY OPTION REVISED. |
| 3 | 1835779 | | T2 AND R8 ADDED. |
| 4 | 1836092 5 17 76 G Sobotka 3-8-76 | | R11 ADDED |
| 5 | 183-7001 4-24-79 S.M.G | | REMOVED R7; A1 WAS 4338-281; A3 WAS 4865-611; REMOVED WIRE P FROM M2 & A3. G Sobotka 5/31/79 P Peradinovic 7/31/79 |
| 6 | 183-7149 5-7-80 J.V.T. | | C17, C18, C19 AND L3 ADDED. P Peradinovic 5/14/80 G Georgakis 6/8/80 |
| 7 | 1837715 1-27-82 J.R. | | C9, C13, C15 REMOVED J. Rader 1/30/82 BWH 1-29-82 |

18:1151

FUNCTIONAL SCHEMATIC
FOR
DC-DC CONVERTER
MODEL HSB3H

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

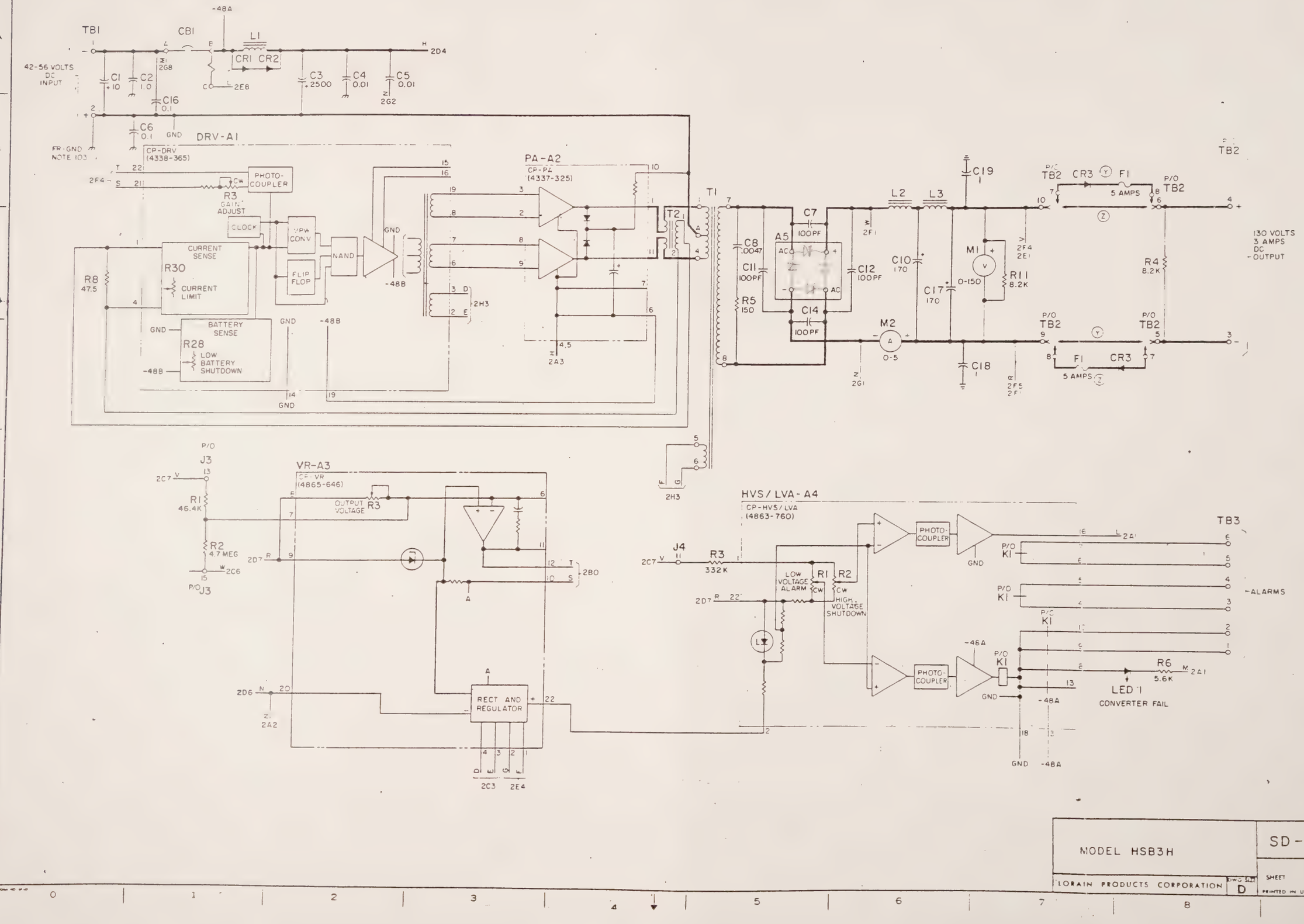
DWG SIZE D

DESIGN N. KAMMILLER ISS —
DRAWN BY V. Rapp DATE 6-13-75
CHECKED BY DATE 6-13-75
CHECKED BY A. RANALLER DATE 8-26-75
APPROVED BY DATE 9-8-75
RATING

SD-5664-022

SHEET 1 OF 2

PRINTED IN U.S.A.




| | |
|---|---|
| MODEL HSB3H | SD-5664-022 |
| LORAIN PRODUCTS CORPORATION | DWG SIZE D |
| | SHEET 2 |
| | PRINTED IN U.S.A. |

# CPS-PA

(POWER AMPLIFIER)

## COMPONENT LIST

### CAPACITORS

| DESIG | CODE |
|---|---|
| (2) C1, C3 | (2724-181) 0.022 UF, 1000V DC |
| C2 | (2731-607) 20 UF, 150V DC, ELECT. |

### DIODES

| DESIG | CODE |
|---|---|
| (2) CR1, CR2 | (2812-220) |

### RESISTORS

| DESIG | CODE |
|---|---|
| (2) R1, R3 | (2651-466) 6.2 OHM, 6 1/2 W, 5% |
| R2 | (2652-488) 1K, 11W, 5% |
| R16 | (2651-105) 1.5 OHM, 3 W, 5% |

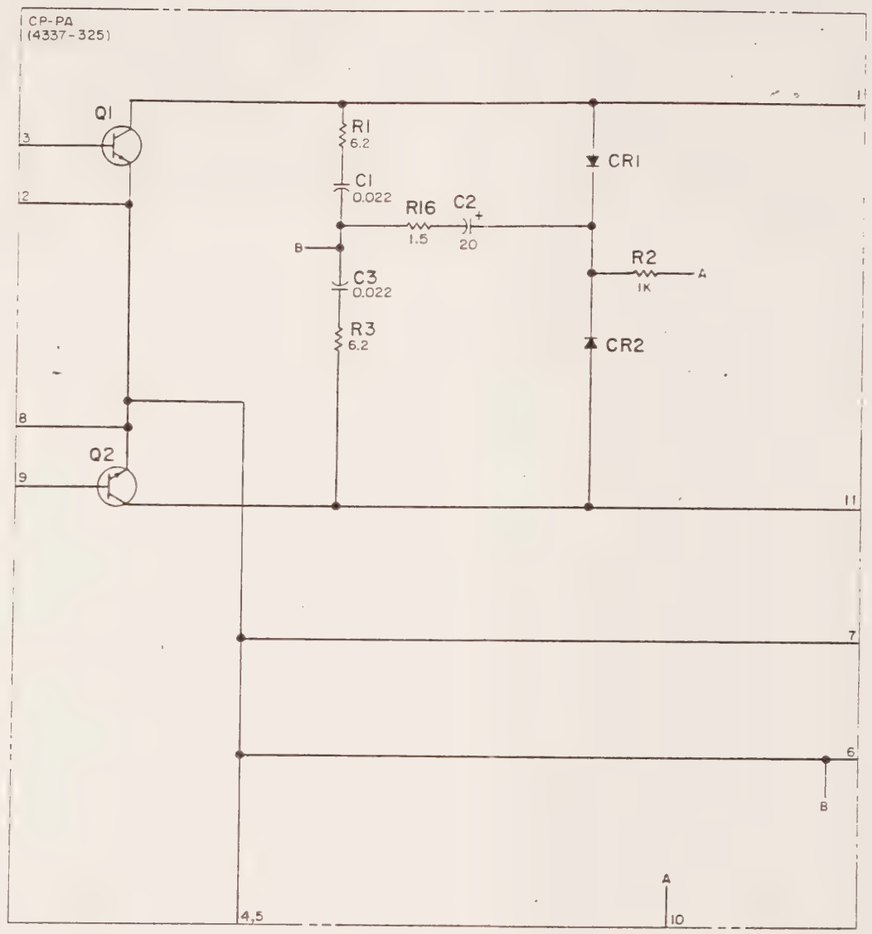
### TRANSISTORS

| DESIG | CODE |
|---|---|
| (2) Q1, 2 | (2842-170) |

## INPUT/OUTPUT INFORMATION

## CIRCUIT DESCRIPTION

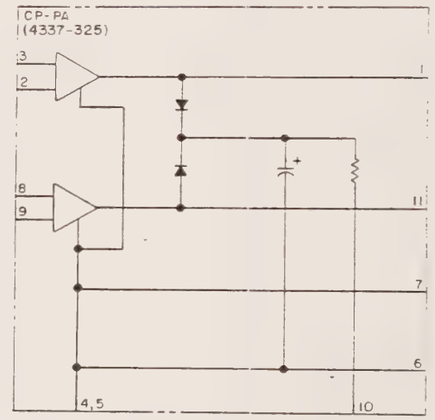
Q1 - Q2 OPERATE IN THE SWITCHING MODE AMPLIFYING A QUASI SQUARE WAVE SIGNAL APPEARING AT 2-3, 8 - 9. R1-R3, C1-C3, CR1, CR2 LIMIT VOLTAGE PEAKS ON Q1-Q2 COLLECTORS




## MANUFACTURING REFERENCES

| CATEGORY | NUMBER |
|---|---|
| ASSEMBLY DRAWING | 4337-325 |
| CONNECTOR ON FRAME | |

## SYMBOL




## NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL + (PLUS), OR - (MINUS), ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2724-181), REPRESENT LPC PART NUMBERS.

REVISIONS

| REV NO. | CHG NO. | CHKD BY | DATE | DESCRIPTION |
|---|---|---|---|---|
| 1 | | | | NEW |
| 2 | 1835708 | L.D. 10-31-75 | 10 23 75 | R16 ADDED |
| 3 | 1835779 | M.R.J. 11-3-75 | 12 2 Nov 75 | R4-R9 REMOVED |

1811081

POWER AMPLIFIER ASSEMBLY

| | |
|---|---|
| DESIGN | N.KAMMILLER |
| DRAWN BY | J. REESE 6-18-75 |
| CHECKED BY | 6-18-75 |
| CHECKED BY | N.KAMMILLER 6-24-75 |
| APPROVED BY | 6-28-75 |
| RATING | STANDARD |

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

DWG SIZE: D

SD-4337-325

SHEET 1 OF 1

COMPONENT LIST

CAPACITORS

| DESIG | CODE |
|---|---|
| (2) C1,4 | (2724-148) 3300PF, 1000V DC |
| C2 | (2731-129) 50UF, 25V DC, ELECT. |
| C3 | (2724-146) 680PF, 1000V DC |
| (2) C5,12 | (2713-118) 0.01UF, 100V DC |
| C6 | (2737-103) 0.1UF, 35V DC, TANTALUM |
| (2) C7,8 | (2713-205) 0.0022UF, 200V DC |
| (2) C9,10 | (2724-090) 0.1UF, 100V DC |
| C11 | (2731-115) 30UF, 60V DC, ELECT |
| C13 | (2731-125) 47UF, 50V DC, ELECT |
| C14 | (2724-143) 0.01UF, CERAMIC |
| C15 | (2737-141) 47UF, 20V, TANTALUM |

DIODE

| DESIG | CODE |
|---|---|
| (11) CR1,2,3,4,5,6,7,8, 15,18,19 | (2811-101) |
| (6) CR9,10,20,21,22,23 | (2812-220) |
| (3) CR12,13,14 | (2835-510) |
| CR16 | (2812-201) |
| CR17 | (2835-411) |
| CR24 | (2834-525) |

INTEGRATED CIRCUITS

| DESIG | CODE |
|---|---|
| A1 | (2871-004) DUAL TIMER |
| A2 | (2876-101) DUAL FLIP-FLOP |
| A3 | (2876-302) TRIPLE NAND |
| A4 | (2876-401) QUAD BUFFER |
| A5 | (4337-040) CURRENT LIMIT ASSY |

RESISTORS

| DESIG | CODE |
|---|---|
| R1 | (2662-408) 5.1 OHM, 2W, 5% |
| R2 | (2615-257) 560 OHM, 1/2W |
| R3 | (2675-117) 5K, 1/2W |
| R4 | (2651-305) 3 OHM, 3W |
| R5 | (2635-678) 12.7K, 1W, 1% |
| (4) R6,11,18,27 | (2615-255) 470 OHM, 1/2W |
| (2) R7,17 | (2651-339) 1.5K, 3W, 5% |
| (3) R8,16,22 | (2615-271) 2.2K, 1/2W |
| (2) R9,14 | (2615-291) 15K, 1/2W |
| (2) R10,13 | (2615-263) 1K, 1/2W |
| R12 | (2635-717) 100K, 1W, 1% |
| R15 | (2635-636) 1.58K, 1W, 1% |
| R19 | (2634-623) 3.32K, 1/4W, 1% |
| R20 | (2651-550) 1.5K, 6-1/2W, 5% |
| R21 | (2634-632) 4.75K, 1/4W, 1% |
| R23 | (2615-235) 2.7 OHM, 1/2W |
| R24 | (2615-303) 47K, 1/2W |
| R25 | (2615-295) 22K, 1/2W |
| R26 | (2635-647) 2.94K, 1W, 1% |
| R28 | (2675-113) 1K, 1/2W |
| R29 | (2634-648) 10K, 1/4W, 1% |
| R30 | (2675-114) 2K, 1/2W |
| R31 | (2634-567) 221 OHM, 1/4W, 1% |
| R32 | (2634-682) 51.1K, 1/4W, 1% |

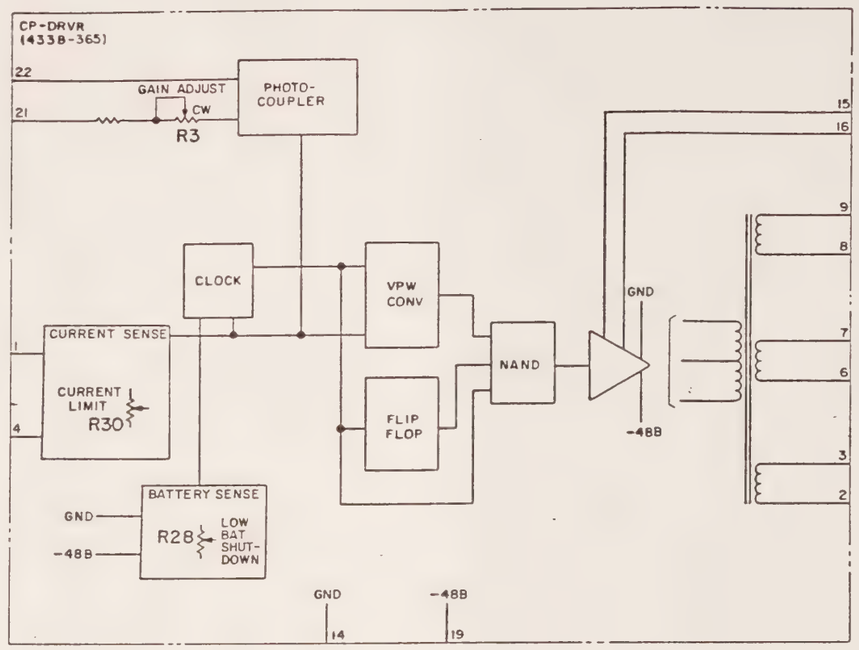
TRANSFORMERS

| DESIG | CODE |
|---|---|
| T1 | (4481-015) |

TRANSISTORS

| DESIG | CODE |
|---|---|
| Q1 | (2857-101) PHOTO COUPLER |
| (2) Q2,5 | (2844-010) PNP |
| (5) Q3,4,6,7,8 | (2841-155) NPN |
| (2) Q9,10 | (2841-100) NPN |

SYMBOL




MANUFACTURING REFERENCES

| CATEGORY | NUMBER |
|---|---|
| ASSEMBLY DRAWING | 4338-365 |
| P.W. BOARD | 3157-193 |
| CONNECTOR ON FRAME | 2475-772 |

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL + (PLUS), OR — (MINUS), ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2662-408) REPRESENT LPC PART NUMBERS.

REVISIONS

| | | | |
|---|---|---|---|
| | | | |

1 (M) NEW. REF. 4338-281 PD MAR 22 1979

2 1836873 6-21-79 S.M.G. (M) CR24 WAS 2834-524. PD G. Schmitz 21 June 79 PD Pending 6/28/79

3 1837320 2-4-81 J.R. (M) C13,15 WERE 2737-141 B. Lam 2-5-81 PD FEB 6 1981 D.J. Brehm 2/6/81

4 1837357 3-23-81 D.A.C. (M) C9 & 10 WERE 2724-106 PD MAR 25 1981 B. Lam 3-23-81 D.J. Brehm 3/24/81

5 1837527 5-18-81 J.R. (M) C15 WAS 2731-125 PD MAY 22 1981 J.C. Ashby 5-22-81 Engineering

CIRCUIT DESCRIPTION

A1 CLOCK GENERATES 40 KHZ PULSE WHICH STARTS RAMP GENERATED IN A1 VOLTAGE/PULSE WIDTH CONVERTER. RAMP SLOPE OF VPW CONV. IS DETERMINED BY CURRENT THRU R12 PROPORTIONAL TO BATTERY VOLTAGE. PULSE WIDTH OUT OF VPW CONV. IS DETERMINED BY RAMP SLOPE AND CONDUCTION OF Q1, WHICH IS CONTROLLED BY REGULATOR CKT AND Q6, WHICH IS CONTROLLED BY INSTANTANEOUS COLLECTOR CURRENT IN POWER AMPLIFIER. A2 FLIP FLOP GENERATES 20 KHZ SQUARE WAVE FROM CLOCK PULSE. CLOCK PULSE, VPW CONV OUTPUT AND SQUARE WAVE ARE COMBINED IN A3 NAND GATE TO FORM TWO OUT OF PHASE WIDTH VARIABLE QUASI SQUARE WAVES AND THEIR COMPLEMENT WHICH ARE BUFFERED BY A4. THE QUASI SQUARE WAVES ARE AMPLIFIED BY Q2, Q3, Q4, Q5 OPERATING IN THE CONSTANT CURRENT MODE. THE COMPLEMENT IS AMPLIFIED BY Q7, Q8 OPERATING AS A CLAMP ON T1 TRANSFORMER PRIMARY. CR12-CR14 DEVELOP BIAS FOR AMPLIFIER TRANSISTORS AND SUPPLY VOLTAGE FOR A1-A4 CIRCUITS. WINDINGS 1,2 AND 3,4 PRODUCE BASE DRIVE VOLTAGE. WINDING 9,10 DEVELOPES POWER TO OPERATE REGULATOR AND ALARM CIRCUITS.

R26, R28 FORM A VOLTAGE DIVIDER ACROSS BATTERY THE OUTPUT OF WHICH IS COMPARED WITH REFERENCE CR17 TO CONTROL Q10 AND Q9. Q9 MAINTAINS C13 AT A LOW VOLTAGE UNTIL BATTERY IS SUFFICIENTLY HIGH TO ALLOW STARTING AT WHICH TIME C13 CHARGES ALLOWING VPW CONV. TO INCREASE PULSE WIDTH. CR20-CR23 RECTIFY OUTPUT OF EXTERNAL CURRENT TRANSFORMER LOCATED IN POWER AMPLIFIER CIRCUIT AND PEAK CHARGE C6. WHEN C6 VOLTAGE EXCEEDS REFERENCE CR1-A5, Q6 CONDUCTS REDUCING CONDUCTION ANGLE THRU CR18 AND CLOCK FREQUENCY THRU CR19 AND R19.

1837001

DRIVER

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

DESIGN G. SCHMITZ ISS. 5
DRAWN BY JJJ DATE 3-13-79
CHECKED BY DATE
CHECKED BY G. Schmitz DATE 3-13-79
APPROVED BY Quality Engineering DATE 3/22/79
RATING STANDARD

DWG SIZE D

SD-4338-365

SHEET 1 OF 2

PRINTED IN U.S.A.

# CPS-DRVR

(DRIVER)

CP-DRVR
(4338-365)

| DRAWING ISSUE | |
|---|---|
| 1 | M |
| 2 | M 6-25-73 |
| 3 | M 9K |
| 4 | M D.A.C. |
| 5 | 9 K M |

C12 0.01 · R2 560 · GAIN ADJ · R3 5K CW · C15 47

Q1

R1 5.1 · R4 3

R5 12.7K · R6 470 · R12 100K

P/O A1 · P/O A1 · A2

A3 G2 · A4 G1 · A3 G1 · A4 G2 · A3 G3 · A4 G3

R8 2.2K · Q3 · R7 1.5K · Q2 · R9 15K · R10 1K · CR1 · R11 470 · CR2 · R13 1K · CR3 · C1 3300PF

T1

R14 15K · R16 2.2K · Q4 · R17 1.5K · Q5 · R18 470 · C4 3300PF · CR9 · CR10

+C2 50 · R15 1.58K

CR4 CR5 CR6 CR7 CR8 · CR15 · C3 680 PF

CR24 · R19 3.32K · R21 4.75K · R24 47K · R25 22K

CR19 · CR16 · CR18 · R29 10K · 51.1K R32 · R30 2K CW CURRENT LIMIT · Q6 · Q9 · Q10 · CR17 · LOW BAT SHUT-DOWN · CW R28 1K · R27 470 · R26 2.94K

R20 1.5K · Q7 · R22 2.2K · Q8 · CR12

CP-CL (4337-040) · SPLY · COM

CR20 · CR23 · CR21 · CR22 · C5 0.01 · C6 0.1 · C7 0.0022 · C8 0.0022 · C9 0.1 · C10 0.1 · C14 .01 · C13 47 · R31 221

CR13 · CR14 · C11 30 · R23 2.7

| | |
|---|---|
| DRIVER | SD-4338-365 |
| LORAIN PRODUCTS CORPORATION · SIZE D | SHEET 2 · PRINTED IN U.S.A. |

ISSUE 5

# CPS-VR

(VOLTAGE REGULATOR)

## COMPONENT LIST

### CAPACITORS

| DESIG | CODE |
|---|---|
| C1 | (2724-090) 0.1UF, 100V DC |
| C2 | (2713-132) 0.1UF, 100V DC |
| C3 | (2724-140) 0.01UF, 1000V DC |
| C4 | (2731-105) 10UF, 50V DC, ELECT |
| C8 | (2731-225) 1100UF, 40V DC, ELECT. |
| C9 | (2724-125) 220PF, 500V DC |

### DIODES

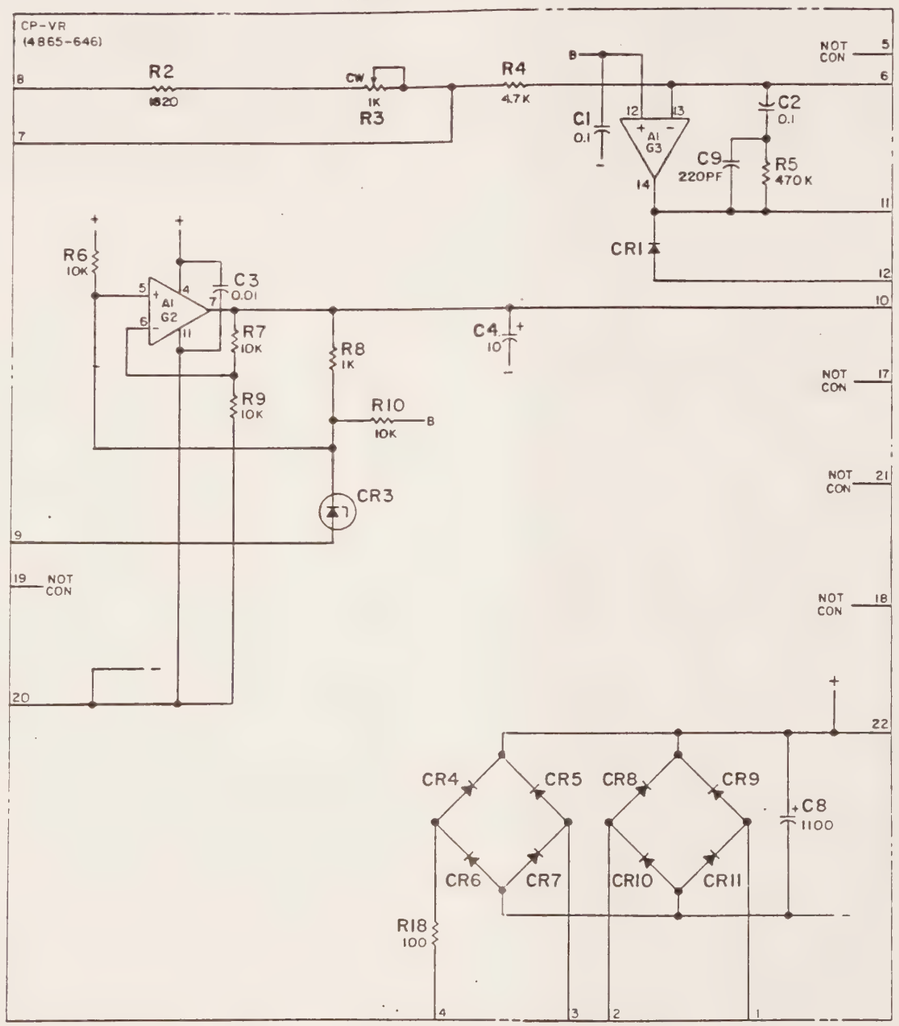
| | DESIG | CODE |
|---|---|---|
| (5) | CR1,4,5,6,7 | (2811-101) |
| | CR3 | (2835-325) 6.2V, 0.4W, ZENER |
| (4) | CR8,9,10,11 | (2812-220) |

### INTEGRATED CIRCUITS

| DESIG | CODE |
|---|---|
| A1 | (2871-115) |

### RESISTORS

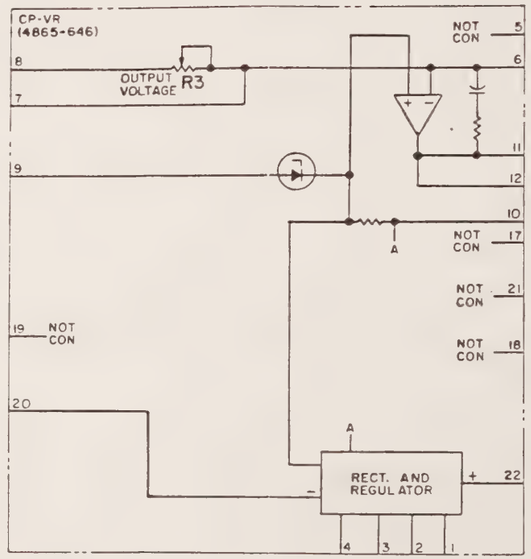
| | DESIG | CODE |
|---|---|---|
| | R2 | (2635-637) 1820 OHM 1W 1% |
| | R3 | (2675-113) 1K, 1/2W, POT |
| | R4 | (2615-279) 4.7K, 1/2W |
| | R5 | (2615-327) 470K, 1/2W |
| (3) | R6,7,9 | (2615-287) 10K, 1/2W |
| | R8 | (2635-624) 1K, 1W, 1% |
| | R10 | (2635-673) 10K, 1W, 1% |
| | R18 | (2615-239) 100 OHM 1/2W |




## MANUFACTURING REFERENCES

| CATEGORY | NUMBER |
|---|---|
| ASSEMBLY DRAWING | 4865-646 |
| P.W. BOARD | 3158-510 |
| CONNECTOR ON FRAME | 2475-776 |

## SYMBOL




NOTES:

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2. CODES WITHIN PARENTHESES, AS (2713-142), REPRESENT LPC PART NUMBERS.

## CIRCUIT DESCRIPTION

A1G1 COMPARES SIGNAL DEVELOPED ACROSS R2, R3 PROPORTIONAL TO OUTPUT VOLTAGE WITH REFERENCE DEVELOPED ACROSS CR3. COMPARATOR OUTPUT CONNECTED BY DIODE CR1. DIODE OUTPUT DRIVES OFF BOARD PHOTO ISOLATOR. A1G3 FUNCTIONS AS A SERIES REGULATOR FOR ISOLATED SUPPLY VOLTAGE DEVELOPED ACROSS C5 AND SUPPLIES PHOTO ISOLATOR AND CR3 REFERENCE. CR4-CR11 COMPRISES ALTERNATE RECTIFIERS FOR 20K HZ POWER FROM DRIVER AND OUTPUT CIRCUITS.

REVISIONS

| LTR | ZONE | DATE | DESCRIPTION |
|---|---|---|---|
| 1 | | | NEW REF 4865-646 |
| 2 | M | 3-18-81 | CI WAS 2724-106 MAK 2-4 3-23-81 |

| | | | |
|---|---|---|---|
| 1837001 | DESIGN G. SCHMITZ | ISS 2 | |
| VOLTAGE REGULATOR | DRAWN BY JJJ | DATE 3-12-79 | |
| | CHECKED BY | DATE | |
| | CHECKED BY G. Schmitz | DATE 3-13-79 | |
| | APPROVED BY Lonnie Pendleton | DATE 3/22/79 | |
| | RATING | | |
| LORAIN PRODUCTS CORPORATION LORAIN, OHIO | DWG SIZE D | SD-4865-646 | |
| | | SHEET 1 OF 1 | |

# CPS-HVS/LVA

(HIGH VOLTAGE SHUTDOWN - LOW VOLTAGE ALARM)

COMPONENT LIST

CAPACITOR

| DESIG | CODE |
|---|---|
| C1 | (2713-132) 0.1 UF, 100 VDC |
| C2 | (2731-103) 10 UF, 100 VDC, ELECT. |
| C3 | (2724-140) 0.01UF, 1000 VDC |

DIODES

| DESIG | CODE |
|---|---|
| (2) CR1,2 | (2812-223) |
| CR3 | (2835-325) 6.2V, 400MW, ZENER |

INTEGRATED CIRCUITS

| DESIG | CODE |
|---|---|
| A1 | (2871-115) QUAD OP-AMP |

RELAYS

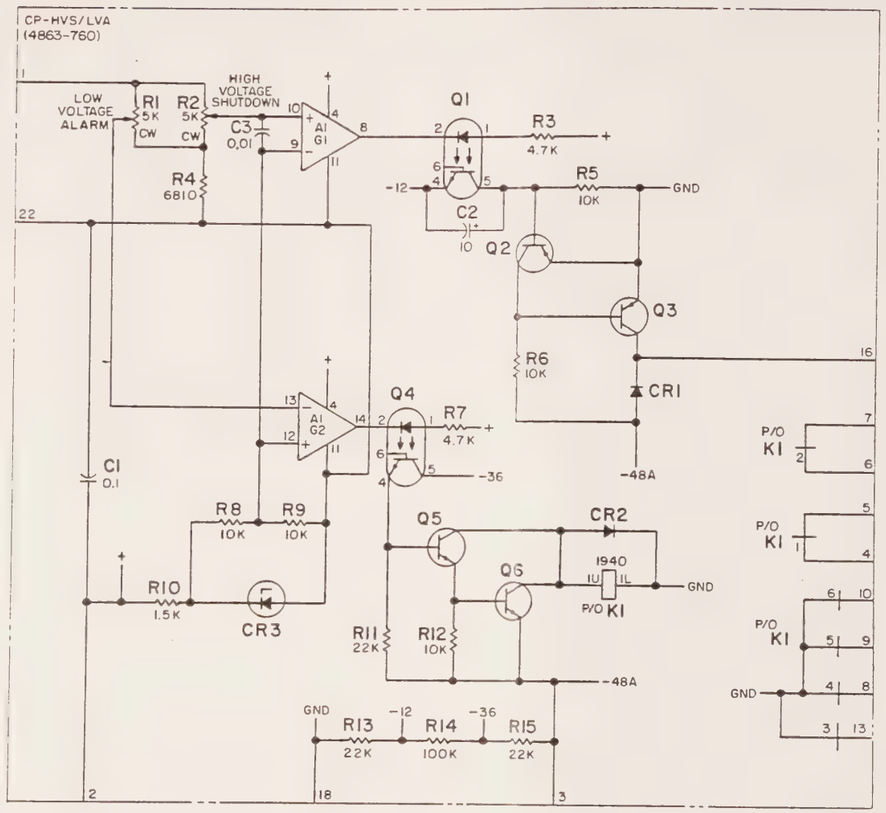
| DESIG | CODE |
|---|---|
| K1 | (2543-443) 1940 OHM, 62V, COIL |

RESISTORS

| DESIG | CODE |
|---|---|
| (2) R1,2 | (2675-117) 5K, 1/2W, POT. |
| (2) R3,7 | (2615-279) 4.7K, 1/2W |
| R4 | (2635-665) 6810 OHM, 1 W, 1% |
| (2) R5,12 | (2615-287) 10K, 1/2W |
| R6 | (2615-487) 10K, 1W |
| (2) R8,9 | (2635-673) 10K, 1W, 1% |
| R10 | (2615-267) 1.5K, 1/2W. |
| (3) R11,13,15 | (2615-295) 22K, 1/2W |
| R14 | (2615-311) 100K, 1/2W |

TRANSISTORS

| DESIG | CODE |
|---|---|
| (2) Q1,4 | (2857-101) PHOTO-COUPLER |
| Q2 | (2843-151) PNP |
| Q3 | (2843-041) PNP |
| (2) Q5,6 | (2841-102) NPN |




INPUT/OUTPUT INFORMATION

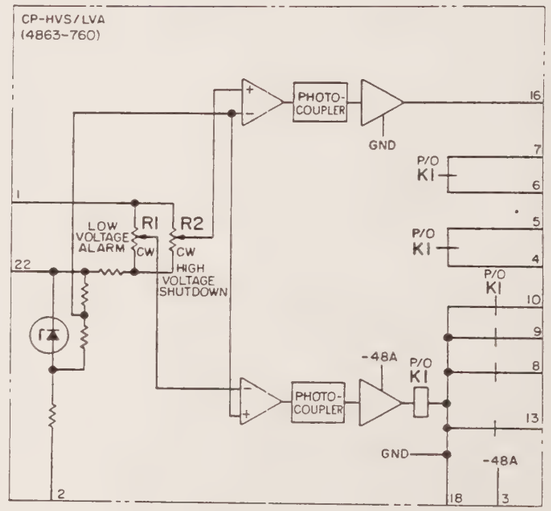
CIRCUIT DESCRIPTION

A PORTION OF OUTPUT VOLTAGE IS DEVELOPED ACROSS R1, R2, R4. IT IS COMPARED WITH REFERENCE DEVELOPED ACROSS CR3 AT A1, G1 AND G2. A1, G1 OUTPUT IS ISOLATED BY Q1 AND AMPLIFIED BY Q2, Q3 TO ENERGIZE COIL OF VOLTAGE TRIP INPUT CIRCUIT BREAKER ON OVERVOLTAGE CONDITION. A1, G2 OUTPUT IS ISOLATED BY Q4 AND AMPLIFIED BY Q5, Q6 TO ENERGIZE K1 LOW VOLTAGE ALARM RELAY

MANUFACTURING REFERENCES

| CATEGORY | NUMBER |
|---|---|
| ASSEMBLY DRAWING | 4863-760 |
| CONNECTOR ON FRAME | 2475-772 |

SYMBOL




NOTES:

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2. CODES WITHIN PARENTHESES, AS (2713-132), REPRESENT LPC PART NUMBERS.

REVISIONS

| ECO NO. | CHG'D BY — CHG. ELEV. NO. | DATE | DESCRIPTION |
|---|---|---|---|
| 1 M | | | NEW |
| 2 | 1835633 | 9 | CONTACT SET ADDED. |
| M B | | 23 | G. Soboca 4-26-75 |
| | | 75 | |
| 3 | 1835779 | 12 | "A" DESIGNATION |
| M B | | 2 | ADDED TO BATTERY |
| | | 75 | SYMBOL |
| G Soboca 12-2-75 | | | |
| 4 | 1835984 | 3 | C3 ADDED. |
| | | 15 | CONNECTOR WAS |
| | | 76 | 2475-776 |
| G Soboca 4-25-76 | | | |

181-1152

HIGH VOLTAGE SHUTDOWN-
LOW VOLTAGE ALARM

| | |
|---|---|
| DESIGN | N. KAMMILLER |
| DRAWN BY | DATE 4-21-75 |
| CHECKED BY | DATE 4-21-75 |
| CHECKED BY | DATE 4-24-75 |
| APPROVED BY | DATE 4-8-75 |
| RATING | |

SD-4863-760

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

DWG SIZE D

SHEET 1 OF 1

PRINTED IN U.S.A.

| SD-DRAWING ISSUES AND T-DRAWING ISSUES AS FOLLOWS | | |

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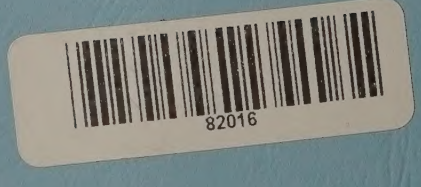
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